

## Beneficial Effects of Extra-Virgin Olive Oil Consumption on Human Health

**Akram Zribi\***

*PhD in Chemistry from the Sfax Faculty of Science, University of Sfax, Tunisia*

**\*Corresponding Author:** Dr. Akram Zribi, Expert in Fats/Oils, Supply Professor of Lipid and Analytical Chemistry at the Higher Institute of Biotechnology of Sfax, University of Sfax, and Senior Training Officer of Statistical Techniques, Tunisia.

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Extra-virgin olive oils are rich in bioactive compounds such as polyphenols, monounsaturated fatty acids (particularly oleic acid), tocopherols, squalene, and sterols which all make it beneficial to the human health. The combination of factors such as the soil composition, the olive tree age, the altitude, the cultivar, the water stress, the degree of the fruit ripeness, the extraction procedures and storage, make our oil rich in these bioactive compounds. Indeed, such oil is the main source of fat in the Mediterranean diet, whose consumption has been associated with a low incidence of breast and colon cancers, neurological disorders and cardiovascular diseases as well as with hypolipidemic and antioxidant properties [1,2].

Several research studies attribute the health benefits of olive oil to its particular fatty acid composition and to its minor components. Indeed, olive oil is characterized by a relative low percentage of polyunsaturated fatty acids and by a high monounsaturated fatty acids percentage (mainly oleic acid). Such compounds are able to decrease both total and low density lipoprotein (LDL) cholesterol levels. They can also protect against age-related cognitive decline and Alzheimer's disease [3].

Besides monounsaturated fatty acids, virgin olive oil contains minor functional compounds, yet significant phenols that other seed oils often lack [4]. Thus, the phenolic fraction of virgin olive oil has generated much interest regarding its health promoting properties. Widmer, *et al.* [5] have shown that olive oil rich in polyphenols able to reduce the incidence of cardiovascular diseases, potentially by improving endothelial function, an important surrogate for atherosclerosis. Additionally, these compounds have proven chemoprotective properties like anticancer and anti-inflammatory in humans [6]. They are also considered as genuine antioxidants [7]. Such compounds are an important parameter for the evaluation of VOO quality as they contribute greatly to oil flavor and taste [8], as long as the oil is protected from autoxidation. VOO can be differentiated from all other vegetable oils owing to its very particular phenolic composition [4]. Indeed, it contains mainly secoiridoids namely aglycon derivatives of oleuropein and ligstroside. It also contains, in low amounts, other phenolic compounds such as lignans, phenolic alcohols, phenolic acids and flavonoids [1].

Other minor compounds like tocopherols, sterols and hydrocarbons are found in virgin olive oil:

- The major lipophilic antioxidant present in olive oil is  $\alpha$ -tocopherol. Indeed, potential health benefits of such compound include prevention of some types of cancer, heart disease, and other chronic diseases [9].
- The major component of the hydrocarbon fraction is squalene, a precursor of sterol biosynthesis and a scavenger of reactive oxygen species, which has been proposed as a causal factor for the low incidence of cancer in Mediterranean populations. In addition to squalene, other hydrocarbons are also present, e.g., the provitamin A,  $\beta$ -carotene, albeit in small amounts [10].
- The phytosterols: they represent a major fraction of unsaponifiable molecules in virgin olive oil. Their consumption conducts to lower levels of plasma LDL cholesterol, and there are several reports on their antitumor effects, especially about  $\beta$ -sitosterol, the main phytosterol of olive oil [10].

Finally, extra-virgin olive oil can prevent other human diseases such as rheumatoid arthritis, diabetes mellitus, and gastrointestinal pathologies [11].

The peculiar fatty acid composition and the richness in minor healthy compounds have led nutritionists to recommend extra-virgin olive oil as the main and best dietary source of fat.

### Graphical Abstract



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